WHAT IS CLAIMED IS:

1. An assembly configured to support at least one optical element to a pre-determined position, the assembly comprising:

a micromachined base having a first mating part;

a payload configured to support the optical element, the payload having a second mating part; and

a connecting structure configured to contact the first mating part of the base and the second mating part of the payload, wherein the connecting structure constrains the payload in about five to about six degrees of freedom with respect to the base.

2. The assembly of Claim 1, wherein the connecting structure constrains and positions the payload.

3. The assembly of Claim 1, wherein the constrained degrees of freedom are pre-determined as to position and attitude.

4. The assembly of Claim 1, wherein the assembly comprises a passive alignment assembly.

5. The assembly of Claim 1, wherein the base, payload and connecting structure are fabricated using a lithographic micromachining process.

6. The assembly of Claim 1, wherein the base and the payload are formed from substantially flat silicon wafers.

7. The assembly of Claim 1, wherein the connecting structure is formed from a substantially flat wafer.

8. The assembly of Claim 1, wherein the base and the payload comprise substantially planar wafers.

9. The assembly of Claim 1, wherein the base and the payload comprise substantially circular rings.

10. The assembly of Claim 1, wherein the six degrees of freedom comprise three orthogonal translational positions constrained to less than one micron and three orthogonal angular positions constrained to less than five arcseconds.

11. The assembly of Claim 1, wherein the connecting structure comprises at least one internal flexure assembly.

12. The assembly of Claim 1, wherein the connecting structure comprises a set of at least two connecting elements, each connecting element having a first mating feature configured to contact the payload and a second mating feature configured to contact the base.

13. The assembly of Claim 12, wherein the set of connecting elements locally constrains the payload and the base in more than six degrees of freedom.

14. The assembly of Claim 12, wherein the set of connecting elements enforces planarity.

15. The assembly of Claim 12, wherein the set of connecting elements increases bending stiffness in the base and payload.

16. The assembly of Claim 1, wherein the connecting structure comprises at least three connecting elements, each connecting element having mating features that are configured to constrain the payload in at least one degree of freedom with respect to the base, wherein the connecting elements together are configured to constrain the payload in a total of six degrees of freedom.

17. The assembly of Claim 1, wherein the connecting structure comprises at least three connecting elements, each connecting element having mating features that are configured to constrain the payload in at least two degrees of freedom with

respect to the base, wherein the connecting elements together constrain the payload in a total of more than six degrees of freedom.

18. The assembly of Claim 1, wherein the connecting structure comprises at least three connecting elements, each connecting element having mating features that are configured to constrain the payload in at least one degree of freedom with respect to the base, wherein the connecting elements together constrain the payload in a total of less than six degrees of freedom.

19. The assembly of Claim 18, wherein the connecting elements provide a desired trajectory of motion for the payload.

20. The assembly of Claim 1, wherein the connecting structure comprises at least three connecting elements, each connecting element having mating features that are configured to constrain the payload in at least two degrees of freedom with respect to the base, wherein at least one connecting element is configured as an optical bench configured to support at least one optical element.

21. The assembly of Claim 1, wherein the connecting structure comprises at least three connecting elements, each connecting element having mating features that are configured to constrain the payload in at least two degrees of freedom with respect to the base, wherein at least one connecting element has an internal flexure assembly.

22. The assembly of Claim 1, wherein the connecting structure comprises at least three connecting elements, each connecting element having mating features that are configured to constrain the payload in at least two degrees of freedom with respect to the base, wherein at least one connecting element has:

a first internal flexure assembly near a first end of the connecting element, the first end configured to contact the base, and

a second internal flexure assembly near a second end of the connecting element, the second end configured to contact the payload.

23. The assembly of Claim 1, wherein the connecting structure comprises at least three connecting elements, each connecting element having mating features that are configured to constrain the payload in at least two degrees of freedom with respect to the base, wherein at least one connecting element has a plurality of attachment points.

24. The assembly of Claim 1, wherein the connecting structure comprises at least three connecting elements, each connecting element having mating features that are configured to constrain the payload in at least two degrees of freedom with respect to the base, wherein at least one connecting element is itself pseudo-kinematically supported.

25. The assembly of Claim 1, wherein the base comprises an internal flexure assembly configured to apply a preload to maintain contact between the first mating part and the connecting structure.

26. The assembly of Claim 25, wherein the internal flexure assembly comprises:

a set of motion flexures; and

a preloader stage coupled to the set of motion flexures, wherein the set of motion flexures provides one soft degree of freedom for the preloader stage to receive a deflection and apply a preload.

27. The assembly of Claim 1, wherein the payload comprises an internal flexure assembly configured to apply a preload to maintain contact between the second mating part and the connecting structure.

28. The assembly of Claim 27, wherein the internal flexure assembly comprises:

a set of motion flexures; and

a preloader stage coupled to the set of motion flexures, wherein the set of motion flexures provides one soft degree of freedom for the preloader stage to receive a deflection and apply a preload.

29. The assembly of Claim 1, wherein the connecting structure comprises an internal flexure assembly configured to apply a preload to maintain contact between the first mating part and the connecting structure.

30. The assembly of Claim 29, wherein the internal flexure assembly comprises:

a set of motion flexures; and

a preloader stage coupled to the set of motion flexures, wherein the set of motion flexures provides one soft degree of freedom for the preloader stage to receive a deflection and apply a preload.

31. The assembly of Claim 1, wherein the connecting structure comprises an internal flexure assembly configured to apply a preload to maintain contact between the second mating part and the connecting structure.

32. The assembly of Claim 31, wherein the internal flexure assembly comprises:

a set of motion flexures; and

a preloader stage coupled to the set of motion flexures, wherein the set of motion flexures provides one soft degree of freedom for the preloader stage to receive a deflection and apply a preload.

33. The assembly of Claim 1, wherein an adhesive attaches the connecting structure to the first mating part of the base and to the second mating part of the payload.

34. The assembly of Claim 1, wherein the base comprises a substrate with a plurality of receptacles, each receptacle being configured to position an optical element.

35. The assembly of Claim 1, wherein the payload comprises a substrate with a plurality of receptacles, each receptacle being configured to position an optical element.

36. The assembly of Claim 1, wherein the base comprises a substrate with at least a first receptacle, the payload comprises a substrate with at least a second receptacle, the pairing of the first receptacle and the second receptacle being configured to position an optical element with about six constrained degrees of freedom.

37. The assembly of Claim 1, wherein the base further comprises a thermal compensation flexure assembly, the thermal compensation flexure assembly being configured to limit distortions due to temperature changes in an attached optical component.

38. The assembly of Claim 1, wherein the base further comprises a strain isolation flexure assembly, the strain isolation flexure assembly being configured to limit strains and distortions in the base imposed by a supporting structure.

39. The assembly of Claim 1, wherein the optical element is an optical fiber.

40. The assembly of Claim 1, wherein the optical element is a lens.

41. The assembly of Claim 1, wherein the optical element is a mirror.

42. The assembly of Claim 1, wherein the optical element is a diode.

43. The assembly of Claim 1, wherein the first mating part and the second mating part comprise slots configured to receive tabs of the connecting structure.

44. The assembly of Claim 1, wherein the first mating part and the connecting structure form a slip-fit joint assembly.

45. The assembly of Claim 1, wherein the second mating part and the connecting structure form a slip-fit joint assembly.

46. The assembly of Claim 1, wherein the connecting structure comprises an internal flexure assembly configured to relieve stiffness in predetermined degrees of freedom.

47. The assembly of Claim 46, wherein the connecting structure comprises a ball joint flexure assembly.

48. An assembly configured to position at least one optical element to a pre-determined position, the assembly comprising:

a base plate; and

at least one side plate configured to connect to the base plate, wherein the base plate and the side plate are configured to support a plurality of payload plates, each payload plate being configured to connect to the side plate and to the base plate, each payload plate being configured to position at least one optical element.

49. An assembly configured to position at least one optical element to a pre-determined position, the assembly comprising:

a micromachined base having a first mating part;

a payload configured to position the optical element, the payload having a second mating part; and

a connecting structure configured to contact the first mating part of the base and the second mating part of the payload, wherein the connecting structure constrains the payload in fewer than six degrees of freedom with respect to the base, such that a trajectory of the payload relative to the base is relatively unconstrained.

50. The assembly of Claim 49, wherein the connecting structure comprises a set of parallel connecting elements.

51. The assembly of Claim 49, wherein the connecting structure includes linear actuators in the missing degrees of freedom configured to form a motion control stage.

52. A method of making an assembly configured to position at least one optical element to a pre-determined position, the method comprising:

using lithography to form a first pattern, a second pattern and a third pattern on a substrate for a base, a payload and a connecting structure, the first pattern outlining a first mating part of the base, the second pattern outlining a second mating part of the payload, the third pattern outlining third and fourth mating parts of the connecting structure; and

etching the substrate to form the base, payload and connecting structure according to the first, second and third patterns, wherein the connecting structure is configured to contact the first mating part of the base and the second mating part of the payload, wherein the connecting structure constrains the payload in about five to about six degrees of freedom with respect to the base, the payload being configured to position an optical element.

53. The method of Claim 52, wherein the first, second and third substrates comprise silicon wafers.

54. The method of Claim 52, wherein using lithography to form the first, second and third patterns comprises:

applying a photoresist layer onto surfaces of the first, second and third substrates;

aligning pre-designed masks near the surfaces of the first, second and third substrates;

exposing the surfaces of the first, second and third substrates to a source of radiation; and

removing parts of the photoresist layer from the surfaces of the first, second and third substrates.

55. The method of Claim 52, wherein etching the first, second and third substrates comprises deep reactive ion etching.

56. The method of Claim 52, further comprising:

connecting the first mating part of the base to the connecting structure; and

connecting the second mating part of the payload to the connecting structure.

57. The method of Claim 52, wherein the first pattern further outlines an internal flexure assembly in the base.

58. The method of Claim 52, wherein the second pattern further outlines an internal flexure assembly in the payload.

59. The method of Claim 52, wherein the third pattern further outlines an internal flexure assembly in the connecting structure.

60. The method of Claim 59, further comprising using a micromachining process to decrease a thickness of the flexure assembly in the connecting structure.

61. The method of Claim 52, further comprising removing a photoresist layer after etching.

62. The method of Claim 52, further comprising depositing metal via sputtering onto the first and second mating parts.

63. The method of Claim 52, wherein the first pattern further outlines a plurality of receptacles in the base, the receptacles being configured to align optical elements.

64. The method of Claim 52, wherein the second pattern further outlines a plurality of receptacles in the payload, the receptacles being configured to align optical elements.